

**THE INFLUENCE OF CULTURAL BACKGROUND ON WAYFINDING
CUES IN UNFAMILIAR BUILDINGS**

A Thesis

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by

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ABSTRACT

Building disorientation increases visitors' anxiety, damages the reputation of the organization, and reduces efficiency in visitors and staff. European Americans are better at recognizing and remembering focal objects in scenes than background information compared to East Asians. Combining these two literatures, I conducted an experiment manipulating focal and background wayfinding cues in interiors to test whether European Americans would rely more on focal cues and less on background cues than East Asians. I chose the hotel setting because many inhabitants are unfamiliar with these spaces, often from different cultures, and minimal signage is typical. To perform the same experiment in US and in Korea, I created navigatable virtual environments. Contrary to the hypothesis, there was no interaction between ethnicity and cue type in wayfinding performance. However, consistent with previous studies, European Americans remembered focal objects but did not associate them with their backgrounds. I also provided design guidelines for practitioners.

BIOGRAPHICAL SKETCH

Giyoung Park was born and grew up in Seoul, Korea. After studying architecture at Hongik University in Seoul, Korea, she pursued a Master of Architecture degree at the University of Michigan where she focused on spatial relationships by altering degrees of openness and visual connections. While practicing architecture, she became more aware of the role of physical environment in human wellbeing as well as frequent user-designer gaps. In 2010, Giyoung started the Master of Science program in Design and Environmental Analysis at Cornell University; and in 2012, she started her Ph.D. program to study sociocultural processes in built environments.

To my father, Cheol Hoon Park, and my mother, Jung Sin Kwun

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TABLE OF CONTENTS

| | |
|--|------|
| BIOGRAPHICAL SKETCH | iii |
| ACKNOWLEDGEMENTS | v |
| LIST OF FIGURES | vii |
| LIST OF TABLES | viii |
| CHAPTER 1. INTRODUCTION & LITERATURE REVIEW | 1 |
| CHAPTER 2. METHODOLOGY | 21 |
| CHAPTER 3. RESULTS | 30 |
| CHAPTER 4. DISCUSSION | 36 |
| APPENDIX A. CONSENT FORM | 44 |
| APPENDIX B. EXPERIMENT RECALL QUESTIONNAIRE | 46 |
| APPENDIX C. INDIVIDUALISM-COLLECTIVISM SCALE | 51 |
| APPENDIX D. HOTEL FLOOR PLANS | 53 |
| APPENDIX E. Q-SORT SURVEY IMAGES | 55 |
| APPENDIX F. GUIDED TOUR INSTRUCTIONS | 61 |
| REFERENCES | 62 |

LIST OF FIGURES

| | |
|--|----|
| Figure 1. Kevin Lynch's physical element typology applied in a hotel lobby | 5 |
| Figure 2. Wayfinding cue examples at Hotel 2 decision point 5 | 24 |
| Figure 3. Guided tour route and correct wayfinding task route | 29 |
| Figure 4. Wayfinding performance by cue type | 31 |
| Figure 5. Recall questionnaire correct answers | 32 |
| Figure 6. Cue recognition results from recall questionnaire | 33 |
| Figure 7. Features mentioned in recall questionnaire | 34 |
| Figure 8. Standard cognitive index (change blindness) results | 35 |
| Figure 9. Individualism-collectivism scale scores | 35 |

LIST OF TABLES

| | |
|---|----|
| Table 1. Kevin Lynch's five elements consisting of a city | 4 |
| Table 2. Experiment design | 23 |
| Table 3. Recall questionnaire included screenshot images at ten decision points | 27 |

CHAPTER 1

INTRODUCTION & LITERATURE REVIEW

Wayfinding difficulties arise in many settings, including inside buildings. Disorientation can increase visitors' anxiety, damage the reputation of the organization, and cause time inefficiencies for visitors and staff alike (Arthur & Passini, 1992; Lynch, 1960). Wayfinding researchers argue that architectural features and spatial organization are more consequential for wayfinding, in comparison to signage and other directional information systems (Arthur & Passini, 1992; Carpmann, Grant, & Simmons, 1985; Passini, 1984). Studies comparing European Americans' and East Asians' cognition indicate that European Americans are better at recognizing and remembering focal objects in scenes, whereas East Asians are more likely to perceive and remember contextual or background information. Conceivably, this might have implications for building design and wayfinding among individuals from different cultures. However, this cross-culture perception research used static stimuli. No studies have tested the potential influence of cultural variability in perception in a three-dimensional real-world wayfinding task.

Combining these two literatures, this study conducted an experiment manipulating focal and background wayfinding cues in building interiors among European American and Korean college students. It was hypothesized that there would be differences between the two culture groups in recognizing and utilizing background cues when wayfinding in unfamiliar built environments. The environments used in the experiment were hotels, one of the building types that expect multinational visitors and overnight guests who may have greater difficulties in finding destinations due to their unfamiliarity with the buildings. We utilized dynamic 3-dimensional simulation in order to manipulate specific design variables

and control for building familiarity.

Spatial cognition and wayfinding

When in a novel and large environment, such as a city or the inside of a large building, where you cannot see the whole space from one location, people selectively gather information from the surroundings through their sensory organs. Over time, they gradually build perceived information like patterns and images into their cognitive representation of the setting (Fraix, 1973; Evans, 1980; Evans & Gärling, 1991; Gifford, 2007; Lynch, 1960; Sternberg, 2009). The product of the perceptive and cognitive processes is called a cognitive map, and the ease of cognitive map construction is termed legibility. Physical attributes of the space, sociocultural context, personal experience, the purpose of being in the space, how the features are arranged in the space, and the degree of familiarity are among the factors that affect cognitive mapping (Fraix, 1973; Evans, 1980; Evans & Gärling, 1991; Gifford, 2007). Cognitive maps primarily aid orientation and thus reaching a destination efficiently. This may affect human well-being by elevating and reducing the individual's anxiety or stress level (Arthur & Passini, 1992; Evans, 1980; Evans & Gärling, 1991; Passini, 1996).

To measure cognitive maps, researchers have utilized several methods, including sketch maps (e.g., Evans, 1981; Lynch, 1960), wayfinding performance in either real (e.g., Evans et al., 1980; Weisman, 1981) or simulated space (e.g., Carpmann et al., 1985; Evans, Skorpanich, Gärling, Bryant, & Bresolin, 1984), photograph recognition, recall-test, thinking-out-loud, and distance estimation between two points (Evans et al., 1982; Gifford, 2007; Peponis, Zimring, & Choi, 1990; Stokols, 1995).

Wayfinding, coined by Kevin Lynch (1960) in his book *The image of the city*, is more than a measure of spatial cognition. It encompasses the process of traveling to a destination

and is still being investigated by many researchers because many people encounter wayfinding problems. There are some types of buildings that intentionally disorient people for longer exploration (e.g., labyrinths, shopping malls, museums). However, ambiguity is discouraged in most building types because disoriented individuals may feel stupid, frustrated, anxious, or even angry when getting lost (Arthur & Passini, 1992; Evans, 1980). Moreover, if many visitors get lost, not only will staff have to spend significant time on helping their wayfinding, the organization may also invoke negative impression (Arthur & Passini, 1992).

The primary focus of the present paper is wayfinding in unfamiliar buildings, and how it might vary among ethnic groups. An individual's wayfinding performance in an unfamiliar environment is influenced by the characteristics of the environment and by personal traits. The environmental attributes include physical features, structural configuration, context, and signage; and personal traits involve variables, such as age, gender, cognitive and physical abilities, preferred cognitive mapping strategies, and affordances¹.

Physical elements and features


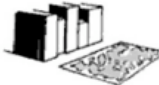



Visual and other sensory cues, such as shape and smell, are essential to cognitive mapping (Arthur & Passini, 1992; Evans et al., 1980; Hall, 1969). Visual information is probably more powerful than other sensory cues in many instances including wayfinding (Archea, 1977; Gifford, 2007; Hall, 1969; Sternberg, 2009). Adding to Appleyard's (1976) sketch map analysis, Evans, Smith, and Pezdek (1982) studied building characteristics in urban spaces that affected the likelihood of verbal recalling. Some features they found

¹ Affordance is underlying properties that clarify how to use the thing (Norman, 1988). Affordance in built environment is clear cues that exhibit the basic functions of the space and how to use it.

salient included building size and shape, building contour clarity, the visibility of the building from roads, and signage.

Lynch (1960) investigated physical elements in urban space that contribute to the legibility of the city, and categorized them into five groups: paths, edges, districts, nodes, and landmarks. Among them, he supposed landmarks and edge clarity would be more effective in creating a legible space. These five types physical elements of a city are summarized in Table 1. Considering that people spend nearly 90% of their time indoors (Air Quality Sciences, Inc., 2008), it is worth analyzing interior elements of buildings. Figure 1 illustrates Lynch's typology and suggests possible analogy for interior hotel environments. Hotel settings may have many users who are unfamiliar with the environment, in addition to some examples in hotels in Table 1.

Table 1. Kevin Lynch's five elements consisting of a city².

| Elements | Description | In cities | In hotels |
|---|--|--|---|
|  | Channels that people move along and perceive environmental information along them. | Streets Highways | Guestroom corridors |
|  | Boundaries; may or may not work as a path. | Shorelines Streets between two neighborhoods | Carpeted seating area in a stone-tiled lobby |
|  | Area that shares same identity; the unique character can be identifiable inside the district and maybe from outside. | Chinatown in New York City Historic district in San Francisco | Conference area Guestroom floors |
|  | Popular foci of districts; people can enter; often junctions of paths. | Union Square in NYC Urban plazas | Lobbies Bars |
|  | Reference points without entering; people do not enter; often associated with verticality. | Empire State Building Eiffel Tower | Chandeliers Water features Grand staircases |

² Diagrams excerpted from the book *The image of the city*, (Lynch, 1960, p.47-48).

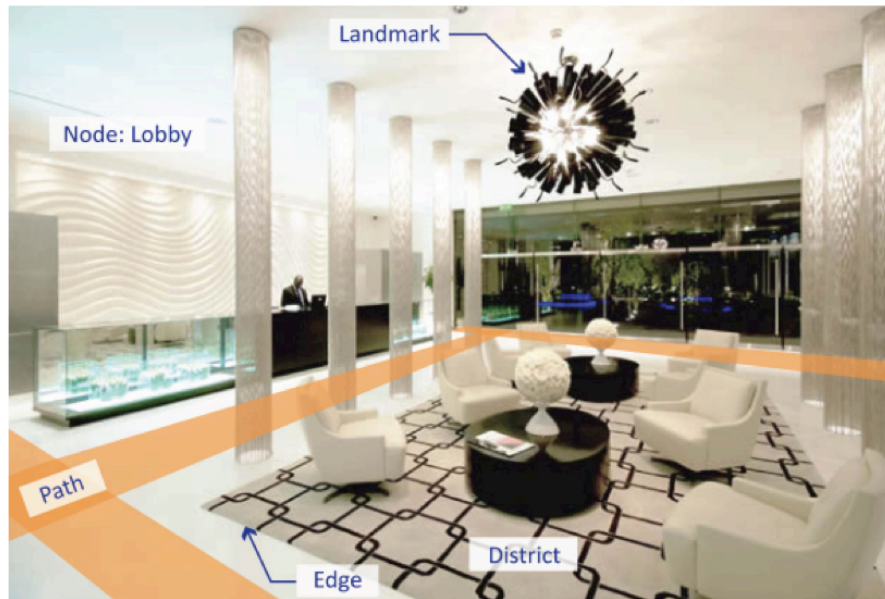


Figure 1. Kevin Lynch's physical element typology applied in a hotel lobby.

There are two different hypotheses about what sequence people learn a novel environment (Evans, 1980; Evans, Marrero, & Butler, 1981; Gifford, 2007). Although Lynch guessed that landmarks would be utilized in initial cognitive mapping process, he did not test his hypothesis. Evans, Marrero, and Butler (1981) tested Lynch's hypothesis using American college students at two novel campuses in Irvine, California and in Bordeaux, France. They compared the participants' sketch maps drawn at two weeks after their arrival and at ten months after. The maps from the both campuses showed that the students learned landmarks sooner than the paths connecting the landmarks. On the contrary, other researchers hypothesized that people would learn paths and districts before using landmarks (Evans, 1980; Evans, et al., 1981; Gifford, 2007). Appleyard (1976) collected sketch maps from residents of a Venezuelan city; and the maps showed short-term residents dominantly utilized sequential information, or paths, compared to their long-term counterpart. Evans (1980; Gifford, 2007) suggested that both hypotheses might be true and dependant on context as well as on personal traits. Sternberg (2009) supported Evans's

explanation by comparing grid and radial systems. She described grid systems would be understood fairly easily, so that people are less likely to rely on landmarks, whereas people would primarily utilize landmarks in wayfinding in radial systems that takes longer time to comprehend.

While landmarks in urban spaces are often tall enough to reference from a distance (Lynch, 1960), landmarks in interior spaces may be obstructed by ceilings and corridors. Previous studies categorized influential features in interior spaces into four attributes: visibility within and outside of the setting; spatial layout complexity; distinctiveness compared to the surrounding; signage systems (Evans et al., 1981; Gifford, 2007; Kaplan, Kaplan, & Ryan, 1998; Weisman, 1981). Recently, Carlson, Hölscher, Shipley, and Dalton (2010) listed three top architectural factors aiding cognitive mapping: visibility to a reference point or landmark; distinctiveness of parts in the building; and the intricacy of spatial configuration. Signage was considered an insufficient aid. Visual access to reference points or landmarks was counted by these researchers, which may suggest that interior spaces need to carefully locate multiple landmarks or reference points and allow visual access to them to make the space more legible.

Spatial layout and complexity

Both Weisman (1981)'s and Carlson et al. (2010)'s studies pointed out overall layout configuration among major architectural variables in cognitive mapping. Yet, as Peponis, Zimring, and Choi (1990) mentioned, one's understanding of spatial layout is not easy to measure because it is the last stage of cognitive map construction after understanding the relationships between environmental features in the space. Some researchers avoid use of sketch maps when analyzing spatial layout because individuals' cognitive maps may be

different from their sketch maps. For instance, Weisman (1981) had a group of participants rate the preference, complexity, describability, memorizability, and apparent wayfinding difficulty of the buildings' main circulation diagrams. He then compared the ratings with wayfinding performance in real buildings using another group of participants. All buildings in the experiment used double-loaded corridors—that is, rooms are arranged on both sides of corridors. Therefore, the participants were not able to use outdoor views as reference. He found that the complexity of plan configuration was closely related to wayfinding difficulty.

While Weisman used participants' subjective ratings of spatial-layouts, other researchers have developed more objective analytic methods. One group of researchers used the number of immediate connections to adjacent spaces and the number of steps from a space to reach all others within the environment. These measures are part of space syntax theory (Haq, 2003; Hillier, 1996; Peponis et al., 1990). The researchers categorized component spaces into four types by the number of connecting spaces from a component space. The number of connections can predict how integrative or sequential the layout is, which can predict travelers' movement (Hiller & Tzortzi, 2006; Hillier, 1996; Peponis et al., 1990). In addition, the greater number of spaces to pass through to reach a component space, the more sequential the layout is, and the less likely the space is visited (Haq, 2003; Hillier, 1996). Haq and Zimring (2003) noted, however, people appeared to use physical elements near them when new to the environment and then gradually manifested wayfinding behaviors consistent with space syntax (Gifford, 2007).

Isovist theory also takes the geometry of a space into account and mathematically estimates human movement into the space. Both space syntax and isovist theories agree

that spatial organization controls available information about surroundings, so that it influences human behavior (Archea, 1977; Benedikt, 1979; Haq, 2003). The primary difference between the two theories is that isovist started from the notion that an individual becomes 'the center of dynamic field of information' about surroundings. Benedikt (1979) defined isovist as 'the set of all points visible from a given vantage point in a space (p.47).' He determined six geometric measures to be effective indicators: area, parameter, occlusivity, variance, skewness, and circularity (Benedikt, 1979, p.127). Researchers concluded that the length of visibility—that is, how far you can see—is a good indicator of the amount of visual information one can acquire at a given point (Barry, 2001; Benedikt, 1979). A space syntax researcher, Haq (2003) mentioned that 'nodes,' among Lynch's physical elements, are where people pause to make a route decision or where they acquire information of upcoming environment as they move. Then, the visibility length at nodes may leverage the amount of available information about upcoming route options. Clearly, schemata formation may have important sociocultural roots.

Contextual factors

Additional work has identified two types of contexts influencing wayfinding: relative physical distinctiveness (Appleyard, 1976; Carlson et al., 2010; Kaplan, et al., 1998; Weisman, 1981) and situational context. Some features that may add wayfinding include finish materials (e.g., colors and materials of surface materials), the angles of component spaces in a building, corridor width, protrusion into pathways, edge/boundary clarity, and ceiling height. The significance of certain visual information as a wayfinding cue may vary by how distinct they are and how far from the decision point (Arthur & Passini, 1992). Wall textures, for example, can serve as a reference point, if highly contrasted to its surrounding

finish materials and visible from a decision point (Evans, Fellows, Zorn, & Doty, 1980). If they are congruent with the surrounding, they become part of the background and contribute to the identity of the space. Likewise, if the identity of a component space is distinguishable from the surrounding, the space can act like a landmark or a reference point.

In addition, if a unique feature is also aesthetically pleasing, it may be more likely acts as a landmark or lead travelers toward it. Hildebrand (1999) and Evans and Gärling (1991) listed a few architectural features or moments that draw people toward them. One of them is mystery. Kaplan and colleagues (1998) defined mystery as “some promise that one can find out more as one keeps going (p.16)” beyond their visible field. A glimpse or a partial view of an adjacent area or scenery through a narrow window along a path, for instance, can intrigue people and encourage for further information. Another spatial feature using mystery could be a curved corridor that does not reveal the destination or the other end (Hildebrand, 1999; Kaplan, Kaplan, & Ryan, 1998).

Light can be a major contributor controlling movement in a space because people have tendency to move from dark to light (Alexander, 1977; Brown, Wright, Brown, 1997; Hildebrand, 1999). Either environmental design or time of day can create and manipulate light and dark juxtaposition. When weaving through lightness and darkness, the rhythm can encourage movement as well as enrich spatial sensation. Similarly, successful juxtaposition of colors or textures could intrigue travelers.

On the other hand, situational context may influence one’s wayfinding. For instance, one would associate awnings and outdoor seating with a restaurant rather than a law firm. Therefore, when looking for a restaurant, awnings can be a reference feature; but

when looking for a law firm, they become part of background. Some architectural features are more likely associated with certain types of spaces. In addition, some types of buildings may have a typical spatial organization: building schemata (Evans, 1980). When corresponding to the design typology of a destination's function, the design features have more potential to become landmarks.

Personal traits: age, gender, and personal background

Jean Piaget (Evans, 1980; Gifford, 2007) suggested that humans learn different cognitive-map methods through development. Young children use egocentric strategies, in which they perceive surroundings in relation to their current position in the space. Around an entrance to an elementary school, children develop projective perception and utilize landmarks to orient themselves. The last stage of cognitive map development is Euclidean representation, which typically emerges around middle school. At this point, children can reduce their dependence on landmarks and understand the pattern of their neighborhood like a map using distances and angles between buildings and environmental features in the space. This Euclidean representation may develop through young adulthood. Lawton and her colleagues (1994, 1996) detected older college students more likely used Euclidean method than their younger counterparts. On the other hand, elderly nursing home residents' sketch maps of their facilities were less accurate than young adults, which could result from their limited mobility (Walsh, Krauss, & Regnier, 1981; Weber, Brown, & Weldon, 1978). Evans and colleagues (1982) found out the symbolic meanings of buildings (e.g., where they got married) were much more salient for elderly residents than young adults in Orange, California.

Many studies have found gender differences in cognitive map and wayfinding

performance (Evans, 1980; Galea & Kimura, 1993; Gifford, 2007). Researchers found that male adults, compared to females, tended to have Euclidean cognition when building a cognitive map of their neighborhood (Appleyard, 1976; Galea & Kimura, 1993; Orleans & Schmidt, 1972, as cited in Evans, 1980, p.275). In addition to supporting this, Lawton and colleagues (1994, 1996) noticed their female participants reported greater uncertainty and higher anxiety during wayfinding tasks. However, the gender differences in cognitive map could result from early experiences (Lynch, 1977, as cited in Evans, 1980, p.276; Gifford, 2007). Lynch discovered that females who grew up in cultures where parents allowed them to travel as far as boys from home demonstrated equivalent level of cognitive mapping skills. Galea and Kimura (1993) also found males and females did not show difference in route-learning.

Lastly, the symbolic meaning of a building (e.g., a temple, a memorial hall) and the uniqueness of the building function (e.g., a post office, train station) could increase the likelihood of remembering the building (Appleyard, 1976; Evans, Smith, & Pezdek, 1982). Another potential influence is the amount of people or objects moving around the buildings, such as a long waiting line in front of a building, people with big shopping bags from a specific store, or greyhound buses going in and out of a bus station (Evans, et al., 1982). Additionally, people probably understand more easily the spatial structure of a new environment if it is similar to the environment they grew up or live in. These factors are related to personal experience and may be effective in some cultures and not in others.

Signage

Even though signage is a ubiquitous component of wayfinding design, it is often not sufficient as a primary wayfinding aid (Arthur & Passini, 1992; Carpmann et al., 1985;

Carlson et al., 2010; Ulrich, Zimring, Quan, Anjali, & Choudhary, 2004). Carpmann et al.' (1985) experiment, for example, showed that visual access to an entrance superseded the entrance signage in a university hospital parking lot. In addition, Ulrich et al. (2004) mentioned that the effectiveness of signage in complex buildings often becomes insignificant, even when properly designed. On the other hand, some studies revealed that when written labels were provided (e.g., library), people did not remember the physical features of the buildings or utilize them as wayfinding cues (Gifford, 2007; Pezdek & Evans, 1979). Given that signage is beyond the scope of the present study, no further discussion is provided here.

Cultural differences in visual perception

Researchers have studied culture and ethnicity from diverse points of views. Among them, a group of researchers have investigated differences in visual perception between European Americans and East Asians. These two culture groups look at, remember, and recognize different information from scenes. Specifically, the former were better at recalling focal objects and at detecting changes in them than background information by far, while the latter were more sensitive to background objects (Masuda & Nisbett, 2006; Nisbett & Masuda, 2003; Nisbett, 2003). In addition, European Americans looked at focal objects sooner and longer and memorized them independently from the background. On the contrary, East Asians not only paid more attention to background information but also associated focal objects with the background (Chua, Boland, & Nisbett, 2005; Masuda & Nisbett, 2001).

These perception differences between Western and Eastern may be rooted in primitive times: hunter-gatherers versus planters (Nisbett, 2003; Nisbett & Masuda, 2003;

Nisbett & Miyamoto, 2005; Triandis, 1995). Hunters and gatherers earned more or less depending on one's own ability and diligence, whereas farmers needed to cooperate with others for a longer period of time or until they harvested to maximize their crops. Thus, farmers valued social harmony within their communities. Additionally, the mythologist, Joseph Campbell argued that Western myths are connected to primitive hunters while Eastern ones are associated with primitive planters, which supports this hypothesis (Triandis, 1995, p. 24).

Another hypothesis seeks the origin of these Eastern-Western differences in philosophy: ancient Greece versus ancient China (Nisbett, 2003; Nisbett & Miyamoto, 2005; Triandis, 1995). Winning in political debates meant financial success for Greek sophists. They cared about the end and disregarded the means. When a sophist was not successful, he would simply move to another city where he could demonstrate his abilities better. Consequently, they valued individual skills and traits for their own success rather than for the common interests and benefits of their groups and societies. On the contrary, Confucius stressed virtue and individuals' duties to their families and communities. Based on the typology of interpersonal relationships they formulated, such as father-and-son, Confucians clarified one's duties and proper attitudes to maintain those relationships, which they thought essential for sustaining their society. Hence, self-development was encouraged for fulfilling one's duties as his group expected rather than for winning.

Both hunter-gatherers and ancient Greek sophists focused on individuals' skills and success that would bring affluence and financial rewards. They valued their own goals and values more important than the group's because they viewed themselves as independent entities from the society. This independent social pattern is called individualism (Kitayama

& Uskul, 2011; Nisbett, Peng, Choi, & Norenzayan, 2001; Triandis, 1995). Planters and Confucians, on the other hand, regarded themselves as part of their groups and thus were not separable. They would prioritize their group's values and goals higher than their own. This interdependent social pattern is called collectivism (Kitayama & Uskul, 2011; Nisbett et al., 2001; Triandis, 1995). In collectivist cultures, individuals are tightly associated with in-group members, while they tend to exclude out-group members.

These two social pattern concepts have been investigated and named differently³ by many researchers (Nisbett, 2003; Triandis, 1995). For instance, North Americans were more likely describe personal characteristics compared to Japanese (Cousins, 1989; Kanagawa, Cross, & Markus, 2001). Moreover, East Asians tend to sort objects by relationships while European Americans likely group them by attributes and membership (Nisbett & Masuda, 2003) – when given a cow, a chicken, and grass to create a pair, East Asians usually link a cow and grass because cows eat grass while European Americans pair a cow and a chicken because they are animals (Chiu, 1972, as cited in Nisbett & Masuda, 2003, p. 11164). No culture, however, is absolutely individualistic or collectivist. Instead, individuals mix individualism and collectivism depending on the situation, which varies among cultures (Triandis, 1995). When they are with their families, for example, people tend to be more collectivist, regardless of culture. When they are at work, on the other hand, some cultures would expect collectivist relationships whereas others would presume individualistic ones (Nisbett, 2003; Triandis, 1995).

Many Eastern and Western societies have been industrialized, so the hunter-

³ Some researchers gave different names to social pattern concepts. Individualism and collaterality (Kluckhohn, F., & Strodtbeck, F., 1961); independence from the frame and dependence on the frame (Witkin & Berry, 1975) – field independent and field dependence; agency and community (Bakan, 1966) are among the different names Triandis (1995, p.7) quoted.

gatherer-versus-farmer and Sophist-versus-Confucian dichotomies are no longer applicable. Yet, the Western world remains more individualistic than the Eastern world because individualism and collectivism have been passed down by caregivers and language (Kitayama & Uskul, 2011; Nisbett, 2003; Nisbett & Masuda, 2003; Nisbett et al., 2001). For instance, European American mothers label objects and point out their features; and in consequence, they use more nouns than verbs when playing with their young children. East Asian mothers, on the contrary, tell their babies about relationships between objects, using more verbs than nouns (Bornstein, Azuma, Tamis-LeMonda, & Ogino, 1990; Fernald & Morikaway, 2005; Gopnik & Choi, 1995; Tardif, Shatz, & Naigles, 1997; Tardif & Xu, 1999). Individualism and collectivism are also reflected in languages. Koreans, for example, say 'our' daughter and 'our' teacher when their spouses or classmates are not present, instead of 'my' daughter and 'my' teacher. The cultural difference in attention manifests in childhood (Duffy, Toriyama, Itakura, & Kitayama, 2009; Nisbett, 2003; Nisbett & Miyamoto, 2005): Duffy and colleagues (2009) discovered that North American and Japanese children who were older than six years old started to show differences in framed-line test⁴, but 4 to 6 year older children did not. Additionally, bicultural people, such as Chinese Americans, can be flexible between individualistic and collectivist in cognition (Hong, Morris, Chiu, & Benet-Martinez, 2000; Peng & Knowles, 2003).

Culture and spatial cognition

Evans (1980) suggested there may be spatial cognition differences among societies and social classes based on a few available studies. For example, Appleyard (1976; Evans,

⁴ Framed line test presents a line in a square box. After removing the image, participants are asked to draw a line in a different or same size square either same length as the initially presented line (absolute task) or in same proportion in relation to the box (relative task). This test is to examine if a participant associates the line and the box in the original image or remember them separately.

1980) discovered that the environmental perception and the cognitive map of Venezuelan citizens varied by class dynamic. Specifically, people in higher socioeconomic status (SES) groups more likely understood and utilized the relationships of environmental features than those in lower SES groups. On the other hand, children's cognitive mapping differences among social and ethnic classes in Maurer and Baxter's (1972, as cited in Evans, 1980, p.276) study of six-year-old children among ethnicities showed White and Chicano children drew more built-environment elements while African-American children drew more natural-environment elements. However, Gifford (2007) suspected cognition differences among ethnic groups based on only one anecdote; yet, the Western anthropologist's anecdote in Africa, in which a person from rain forest exhibited different visual and spatial perception from Westerners', seemed to arise from the exposure to different natural environment and the consequent adaptation for survival, instead of ethnicity (Passini, 1984). Thus, it is still unclear if ethnicity influences spatial cognition.

Meanwhile, some physical elements were more salient to some ethnic groups than to others. Evans and colleagues (1982) replicated Appleyard's (1976) in Orange, California. Some building characteristics were effective to both cultural groups while other features were effective to only one group. For example, the 'symbolic significance' of buildings was influential to Orange residents⁵, especially among older residents, but not among Ciudad Guayana residents in Venezuela. Even though the researchers explained the history of the two cities (old versus new) and the frequency of the symbolic buildings' use might result in the difference, this difference might be related to their culture, history, and lifestyle. Gifford (2007) explained that the varying salience of environmental features among cultures

⁵ Symbolic significance was not included in the best prediction regression equation for younger adult samples.

as social legibility. Lastly, people tend to apply general rules they have acquired over time to a new space (Evans & Gärling, 1991), which may be culture-specific. There may be some building types, such as religious temples or vernacular houses, that have created culture-specific layout prototypes.

Hotel

One of the advantages of studying hotel environments is that their layouts are less likely culture-specific. This is particularly true among hotels in developed countries. Architects and designers would also promote wayfinding cues that do not require social legibility. However, they don't intentionally try to create universal wayfinding aids, either.

Being in a novel environment, in addition to fatigue from a long travel, can raise anxiety level. As mentioned earlier, new or occasional hotel visitors and guests are not familiar with or remember their spatial organization from previous visits. In addition, some visitors may be rushed (e.g., getting quickly to a business meeting), which probably makes them even more anxious. Therefore, clear wayfinding can contribute to guests' pleasant and positive hotel experiences as well as to staff efficiency, which is critical to their business success. Conversely, hotels, particularly higher-end ones, consider signage as a branding tool; and thus, they try to integrate the color schemes of the interiors into signage design or tend to prefer neutral colors. This strategy can make signage less effective as a wayfinding aid or even less detectable.

Target customer groups are one of the primary factors that determine preferred locations, site characteristics, amenities, and many other aspects in hotel planning. Some hotel types choose urban areas despite expensive yet small sites. Downtown hotels, for example, tend to be organized vertically to fit amenities and guestrooms into a limited site:

then, the visitors would more likely refer to signage and take elevators to destinations. One of the most common planning strategies for urban hotels is to locate public spaces on or close to street level and to place guestrooms on upper levels. This strategy can create several layers of transition zones between the public amenities and guestrooms that provide visual and auditory privacy for overnight guests. This can also help guests and visitors to understand the spatial structure.

On the other hand, other hotel types offer extensive amenities and lay them out horizontally on large sites. Convention, resort, mega, and mixed-use hotels are among them. Recently, medical mixed-use hotels, that integrate medical and hotel facilities in one site or in one building, have increased to meet the needs of patients who travel far from their home, domestically or internationally, for medical treatment or family members or friends who travel to visit patients (Rutes, Penner, & Adams, 2001). Many of those patients prefer staying nearby after being discharged for follow-ups or need time to recover before going back home. When component spaces are spread out horizontally, the spatial structure of a hotel becomes crucial for the visitors' and guests' wayfinding. Wayfinding issues turn out to be more critical due to increased walking distance and greater number of route decision points along journeys to destinations.

The present study simulated two hotel environments on large sites: a convention hotel and a medical mixed-use hotel. Taking advantage of large sites, most of the component spaces were placed on the street level. Thus, the present study could exclude the potential for uncontrolled variables that vertical travel might create. In addition, large convention and mixed-use hotels contain diverse component spaces within one building to accommodate various user needs (Rutes, Penner, & Adams, 2001). This allows a range of

design features for testing their effectiveness as wayfinding cues.

Virtual environments

Wayfinding studies have used lab settings, real spaces, or virtual spaces depending on their research goals. Yet, scant studies have compared wayfinding behavior and strategies in real interior spaces with replicated virtual spaces. Skorupka (2009) compared wayfinding behavior in real and simulated office environments using a between-subject design. She concluded that even though the performance levels were different, the two participant groups used similar cues and strategies to reach their destinations. In addition, Koh and his colleagues (1999) compared the spatial structure knowledge of firefighters who were exposed to either a real office environment or one of the three replicated settings: virtual environment using head-mounted display, virtual environment on computer monitor, and a physical model. Training that used either of the virtual environments or the model turned out to be almost as equally effective as training in the real setting for the firefighters; however, they may have better spatial cognition abilities by training.

Many wayfinding studies have utilized virtual environment to effectively control other variables – for instance, people, sound, signage, weather, and illumination levels. However, there are disadvantage of using virtual environment. One of the major drawbacks is that when not presented in full scale, the scale of the environment would be perceived different from the one of real world. Specifically, landmarks and other design features appear smaller on monitors than in real space. Therefore, the cues may be less influential to cognitive map construction. In addition, the participants' interaction with the environment is different from navigating in real space, as their bodies don't move. Sternberg (2009) suggested motion cues would be the third strongest cue type after visual

and olfactory cues. The motion cues, proprioception, are perceived by the inner ear organs, muscles, and joints. Although lack of proprioception alters navigation experience, this may help isolating visual cues to test in present study. Lastly, Ruddle and Lessels (2006) found that their participants were more likely to miss targets outside or the perimeter of the field of view (FOV) when looking around in virtual open space. They hypothesized a wide FOV could help target-searching behavior in a 10-meter square virtual room closer to the one in real space; however, the wide FOV was not statistically different than a more standard one.

Despite the potentials for the drawbacks, present study found more benefits of using a virtual environment: it was not only able to control other variables, especially setting design and familiarity, but also enabled us to conduct the same experiment in two countries, the United States and Korea.

CHAPTER 2

METHODOLOGY

Objectives

- To determine whether there are differences in the perception and recognition of focal and background wayfinding cues between European American and Korean participants.
- To measure whether specific types of cues are more effective for one cultural group.
- To test whether the difference between two groups of participants can be explained by individualism-collectivism.
- To provide suggestions for architects and interior designers to create more legible environments.

Design

The present study used a cross-over design with focal and background cues and with two hotels, Hotels 1 and 2. Consequently, the hotels had two versions: A and B - for instance, the route decision point 1 in Hotel 1 had a focal cue in version A while a background cue in version B. Participants performed wayfinding tasks in both hotels of set A or of set B; and the order of Hotels 1 and 2 was balanced within the sets. The primary dependent variables were the number of correct route choices in wayfinding tasks and the number of correct change detection in a recall questionnaire.

Navigation environments

Two hotels were created: Hotel 1 was a convention hotel, and Hotel 2 was a medical

mixed-use hotel (See Appendix D for floor plans). The two versions of either hotel used the same floor plan and altered only wayfinding cues (Figure 2). Each model contained five route decision points⁶: two of them with focal cues, two with background cues, and one no-cue condition (Table 2).

The hotel planning and design rules based on the literature review were:

- A route decision point had only two route choices, left and right; and both route options were placed at right angle to the passageway a participant just passed.
- The visibility lengths to both route options at a decision point were matched, and the overall shapes of the routes were not occluded.
- The illumination levels and the amount of visual access to adjacent spaces between route options at a decision point were controlled.
- The numbers of left and right turns along the correct routes were even, and the cue locations in relation to the correct routes as well as to left and right turns were also regulated.
- When taking an incorrect route during a wayfinding task, participants faced a dead-end such as turning around at the end of the corridor. In order to continue the task, they needed to return to the previous decision point. The dead-ends were placed perpendicular to the corridor and set back by several feet; so they were not visible until turning the corners.
- The destinations' functions, a convention room and lecture rooms, were not considered more significant among one culture group than the other.

⁶ Both hotels had one more decision point for realistic hotel planning. These decision points did not restrict design features between the options; and many participants took the correct routes. Data from these points were not included in analysis.

Table 2. Experiment design. Participants were randomly given either set A or set B, and the order of hotels 1 and 2 was balanced within sets. The cues in brackets were background cues, and the others were focal. * ‘On’ means that the cue was on the correct route, and ‘Off’ means that it is on incorrect route.

| Decision point | | Set A | Set B | Correct route | Cue location* |
|----------------|---|---|---|---------------|---------------|
| Hotel 1 | 1 | Artwork | (Recessed ceiling lighting) | Left | - |
| | 2 | - No cue condition - | | Left | On |
| | 3 | (View to garden with subtle finish change) | View to garden with moderate finish contrast | Right | Off |
| | 4 | Trees, tables, and chairs | (Banquet overhang on the side) | Right | On |
| | 5 | (Angle of building component) | Color scheme difference between route choices | Left | Off |
| Hotel 2 | 1 | - No cue condition - | | Right | - |
| | 2 | (Ceiling light fixture) | Artwork | Left | On |
| | 3 | Wall colors on facing walls between route choices | (Corridor width) | Right | Off |
| | 4 | (Wall color on side walls) | Distinct ceiling light | Right | On |
| | 5 | First-aid station | (Ceiling design) | Left | Off |

AutoCAD 2012 and SketchUp 7 were used for designing the hotels; and then Autodesk 3ds Max 2012 and Unreal Development Kit, September 2011 version were used for rendering and creating an easy navigation interface. Even though a wide FOV could present more information in open spaces like lobbies, it turned out to elongate corridors too much, which reduced the size and the salience of wayfinding cues. Since the models contained more corridors than open spaces, the FOV in all four models was set to 95 degree, the default of the Unreal Development Kit software. The screen-view was recorded during wayfinding task using Applian Technologies, Inc.’s VM Capture 3.1.

Q-sort survey

After planning, designing, and building the hotel models, wayfinding cues were placed. The cues included finish materials, the angles of building component space, corridor width, protrusion into pathways, ceiling height and design, lighting fixtures, first-



View to the opposite route option



Background cue (ceiling design)



Landmark cue (first-aid station)

Figure 2. Wayfinding cue examples at Hotel 2 decision point 5. The left top scene is the view to the incorrect route. The top and bottom scenes on the right are the view to the correct route, with a landmark cue (first-aid station) and with a background cue (ceiling design), respectively.

aid station, furniture, and artwork (Table 2). To examine how salient these features were in a given context, a Q-sort was used. The sort included six images each, captured at two route decision points. Both image sets were from one of the models that was most developed at the time of the survey (See Appendix E for survey images). Eight participants from Cornell University sorted the images, one set after another, by how likely they would use the features as a wayfinding cue. Then, the participants were asked which cues were easily recognizable, which were subtle, and which were unidentified. Easily recognizable

features were categorized as focal cues. There were no cues majority of the participants did not recognize; therefore the rest of the cues were considered as background cues. Based on the survey results, the cues were adjusted and placed in the models. The survey participants were not recruited again for the actual experiment.

Participants

Fifty-five college students were recruited from Cornell University in Ithaca, New York and Hongik University in Seoul, Korea for the experiment. They received either research participation credits for academic courses they were taking or small monetary compensation. Even though females in the two countries had likely been allowed to travel away from home in childhood as far as males, gender ratios of the two cultural groups were matched. Additionally, architecture and interior design major students were discouraged in participant recruitment⁷. Nine participants were excluded from data analysis because they were bilingual and/or bicultural⁸. As a result, 23 participants, 7 females and 16 males, in each culture group were valid. The mean ages of the two cultural groups were 20.25 (European American) and 21.52 (Korean).

Apparatus / Setting

The experiment was conducted in a small office with a PC. The computers used in

⁷ There happened to be one architecture student among Korean participants. His performance and recall test scores were equivalent ($p=1.00$) to his group (those who were had same ethnicity x same hotel version x same hotel order). The present study counted him as a valid participant in data analysis.

⁸ Bilingual in this study defines an individual who practiced multiple languages regularly or assessed his or her foreign language proficiency to be the highest in a 5-point scale. Bicultural in this study means an individual either who had lived in a foreign country more than six months and still maintained the language of the foreign country to intermediate level or higher or whose parents were immigrants. There was one female Korean participant who lived in Japan for two years when she was in elementary school, but, she assessed her Japanese level as beginner level. And, her performance and individualism-collectivism index score did not show statistical difference when compared to other participants' in her group. This study included her in data analysis.

the two countries had Microsoft Windows 7 operating system and accompanied with a 23-inch flat screen monitor, a wheel mouse, and a standard keyboard.

Dependent measures

The measures included 1) if participants chose the correct route at a route decision point; 2) whether they looked at both directions before deciding which way to go⁹; 3) whether they recognized altered screenshot scenes from the navigated models and correctly identified the cue changes (recall questionnaire); 4) if they detected focal and background changes in a standard cognitive test; 5) how individualistic or collectivistic the two ethnic groups were to test the hypothesis of visual perception difference (individualism-collectivism scale); and 6) demographic data survey.

The recall questionnaire consisted of ten screenshot images captured from the ten decision points: five from set A and the other five from set B (Appendix B). Whether participants were given set A or B, they had six same scenes (two landmark and two background cues, and two no-cue conditions) as the navigated models and four different scenes (two landmark and two background cues) from the other models (Table 3). To accurately measure if a participant actually perceived the cues and recognized them, the researcher verbally conducted this questionnaire: “Have you seen this scene?” When a participant stated a scene was different from the model, the researcher asked “What is the difference?”

⁹ Pilot test revealed gamers navigated noticeably faster than non-gamers even after navigation practice. The gamers also less likely looked at both route choice options at a route decision point than non-gamers; therefore, the present study instructed participants to look both left and right before deciding which way to go during the experiment to assure they saw the cues.

Table 3. Recall questionnaire included screenshot images at ten decision points. It consisted of six scenes participants saw and four they did not see during wayfinding tasks. Cues in brackets are background cues.

| Decision point | | Presented cue | Set | Order in questionnaire |
|----------------|---|--|-------|------------------------|
| Hotel 1 | 1 | (Recessed ceiling lighting) | B | 4 |
| | 2 | - No cue condition - | A & B | 10 |
| | 3 | View to garden with moderate finish contrast | B | 5 |
| | 4 | Trees, tables, and chairs | A | 2 |
| | 5 | (Angle of building component) | A | 8 |
| Hotel 2 | 1 | - No cue condition - | A & B | 3 |
| | 2 | Artwork | B | 1 |
| | 3 | (Corridor width) | B | 9 |
| | 4 | (Wall color on side walls) | A | 7 |
| | 5 | First-aid station | A | 6 |

Additionally, the present study replicated a standard cognitive index (change blindness) that Masuda and Nisbett's (2006) used; and included an individualism-collectivism scale (Triandis, 1995; Appendix C). The change blindness test Masuda and Nisbett (2006) created presented thirty pairs of scenes, half of which contained focal object changes and the other half had altered background objects, to test cultural differences in visual perception. It presented one scene after another (560 msec each) with a white intermission field (80 msec), and participants were instructed to press a space bar key when detecting a change between a pair of scenes. If a participant did not recognize a change within 60 seconds, it automatically moved to the next pair of scenes. The nine-point-scale individualism-collectivism scale was included to examine the two cultural groups' independence (e.g., "I like my privacy") and interdependence (e.g., "To me, pleasure is spending time with others") levels and to confirm previous studies' findings. Lastly, the demographic data survey included age, gender, living abroad or not, major, foreign language proficiency and the frequency of each foreign language use, and computer game

history¹⁰.

Procedures

Participants were informed the aim of the experiment was to examine how hotel interior design would affect wayfinding behavior. However, participants were not told about the cultural background variable. Participation in this study was entirely voluntary. The researcher conducted the experiment with one participant at a time. After being informed about the experiment procedure and signing on a consent form (Appendix A), a participant practiced moving around in the virtual environment by finding up to three features in a simulated office (a red door, a yellow wall, and a pantry). Those who quickly learned how to navigate were given fewer features to find. Then, the participant took a guided tour of a hotel model using a pre-recorded video. The researcher gave an overview of what type of hotel a model simulated and what component spaces were in the model. Then the researcher verbally introduced component spaces during the guided tour (e.g., “This is the main lobby.” See Appendix F for complete guided-tour instructions). The guided tours started at main lobby as if they just arrived in a hotel. After the tour, a destination was given, which required navigation through a different route from the guided tour (Figure 3). The start point in the task was either in front of their guestroom or in the middle of corridor in a meeting room area. Once the participant reached the destination, the guided tour of the other hotel was given followed by a wayfinding task. After

10 Computer game history asked 1) if a participant had played computer games; 2) whether the games required navigation in three-dimensional spaces or not; and 3) how often and how long they have played and if they played the games at the time of experiment. There were four and six among American, nine and none Korean current gamers and former gamers, respectively. Current and former gamers demonstrated equivalent wayfinding performance and behavior. Therefore, they were combined as ‘gamers.’ Participants were counted as gamers if they had played games that involved navigating in three-dimensional space navigation more than once a week.

completing both wayfinding tasks, the participant did the recall questionnaire, took the standard cognitive test, and verbally answered demographic questions. Lastly, the participants filled out the individualism-collectivism scale that was told to be anonymous.

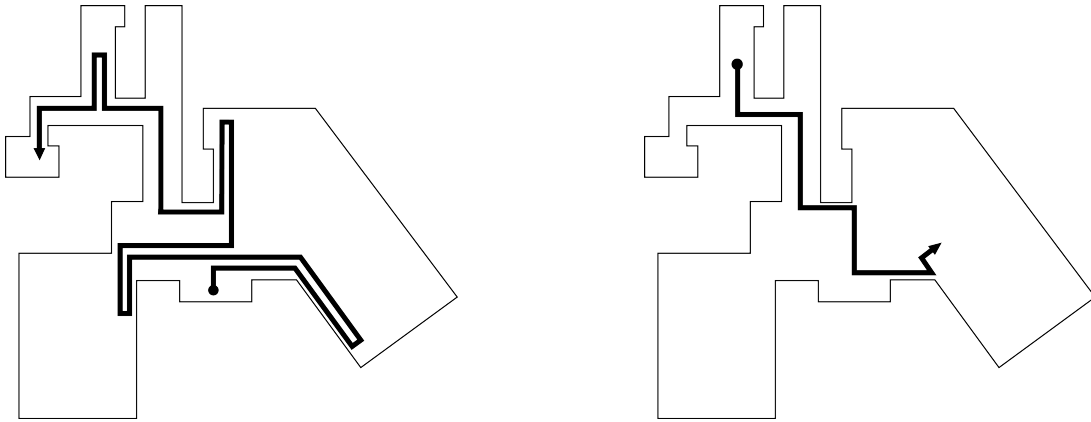


Figure 3. Guided tour route (left) and correct wayfinding task route (right). The navigation requires a different route from the guided tour.

CHAPTER 3

RESULTS

Wayfinding performance

The two hotels (1 and 2) and their two versions (A and B) did not show a main effect or an interaction on wayfinding performance or on perceived difficulties. To measure perceived difficulties, the researcher asked thirteen among the participants which model was easier for them. Although participants indicated the two hotel models were equal in difficulty ($t(12)=-.267$, $p=.794$), hotel order in wayfinding task was marginally significant ($t(42)=1.898$, $p=.073$): those who had Hotel 1 first exhibited better wayfinding performance on average (.72 vs .64). There was no gender difference in wayfinding performance ($t(44)=-1.230$, $p=.225$); however, gamers ($M=7.16$) performed somewhat better than non-gamers ($M=6.52$, $t(44)=1.678$, $p=.100$). Thus, hotel order and gamer/non-gamer were controlled. Additionally, gamers were less likely to check both route options at decision points in pilot test. During the experiment, gamers and non-gamers did not show statistical difference on checking both sides before proceeding at decision points ($t(44) = .292$, $p=.755$).

Overall, Koreans ($M=7.00$) performed slightly better than European Americans ($M=6.77$, Figure 4.), but it was not significant (Chi sq.=.457, $p=.499$). Cue type was significant (Chi sq.=15.407, $p=.000$); however, landmark (mean probability .75) and no-cue condition (.66) showed difference (Chi sq.=9.770, $p=.002$) while landmark and background cues (.66) were only marginally significant (Chi sq.=2.728, $p=.099$). In addition, within each cue type, ethnicity was insignificant (landmark, Chi sq.=.056, $p=.813$; background, Chi sq.=.061, $p=.805$; no-cue condition, Chi sq.=.302, $p=.583$). No interaction between cue type and ethnicity was found (Chi sq.=.113, $p=.945$). Additionally, gamers (Chi sq.=5.452,

$p=.020$) and hotel order ($\text{Chi sq.}=4.634$, $p=.031$) showed difference only with background cues not in the other two conditions.

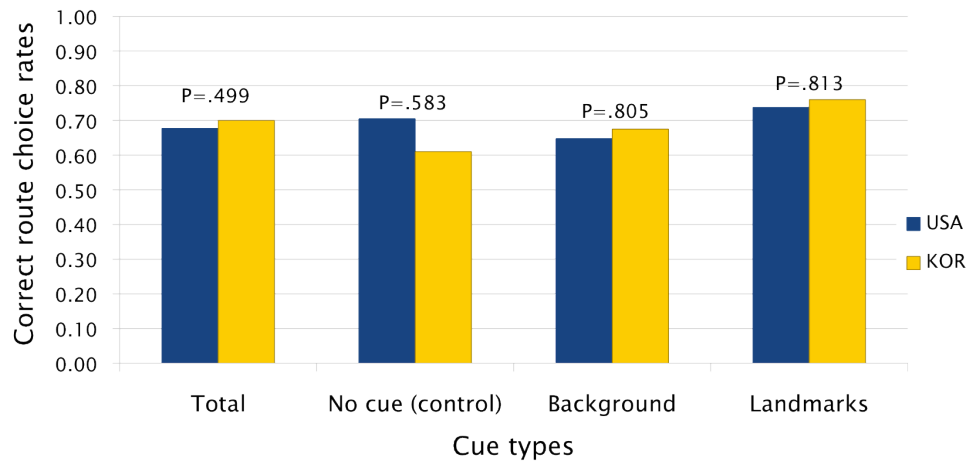


Figure 4. Wayfinding performance by cue type.

Recall questionnaire and cue recognition

The recall questionnaire asked “Have you seen this scene during the experiment?” Koreans’ mean probability to give a correct answer (.69) was higher than European Americans’ (.55, $\text{Chi sq.}=11.283$, $p=.001$; Figure 5). Moreover, Koreans’ mean probability to say No to an altered scene (true negative; .54) was greater than European Americans’ (.35; $\text{Chi sq.}=6.233$, $p=.013$) while the two cultural groups’ probabilities to answer Yes to a same scene (true positive; .79, .69, respectively) were marginally different ($\text{Chi sq.}=2.971$, $p=.085$). Recall test results were not further analyzed whether cue types influenced the probabilities. In altered scenes, participants were exposed to both cue types: for example, a background cue in a model was replaced with a landmark cue in a different scene, or vice versa.

To check response bias and risk-taking tendency in the recall test between the two ethnic groups, the present study used d' (signal detection) and C (risk taking) analyses. Koreans’ responses (mean $d'=.885$) were more accurate than Americans (mean $d'=.163$,

$t(44)=3.236, p=.002$); however, the two groups' were equally conservative in risk taking (mean $C=.352, .449$, respectively, $t(44)=-.654, p=.517$).

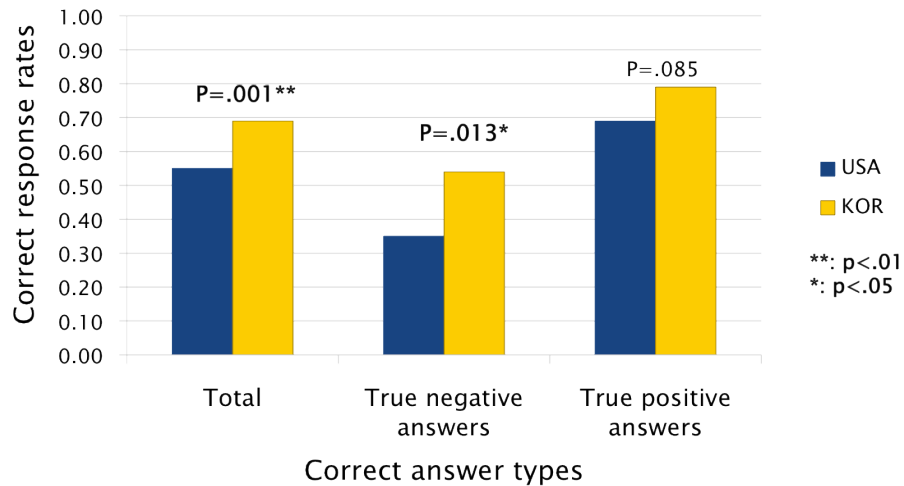


Figure 5. Recall questionnaire correct answers to whether presented scenes were same as navigated models. There was a cultural difference when presented scenes were different from what participants had seen during wayfinding tasks.

The present study also looked at what features the participants indicated were different from what they had seen. The purpose of this measure was to confirm if the participants actually recognized the alterations. Cultural background marginally influenced the likelihood of correct change recognitions in four altered scenes (Chi sq.=3.027, $p=.082$, Figure 6). However, this difference may be explained by Koreans' greater recall questionnaire scores. The probabilities of detecting correct cue changes compared to true negative answers did not vary between the two groups (Chi sq.=.038, $p=.845$). This means that when they stated a scene was modified, the two groups' likelihood to recognize actual change was equivalent. Additionally, the probabilities of correct change detection per true and false negative answers were marginally significant between the two groups (Chi sq.=2.909, $p=.088$).

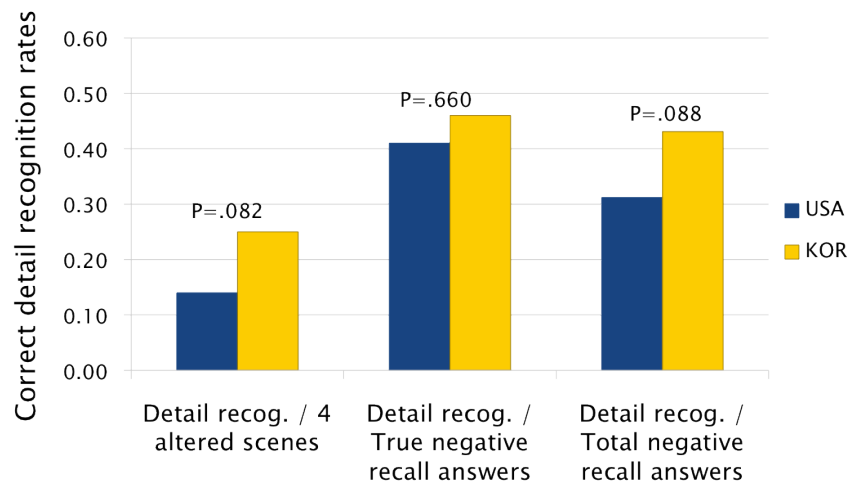


Figure 6. Cue recognition results from recall questionnaire.

In addition, the cue change recognition analysis revealed that the two cultural groups paid attention to different features when moving around in three-dimensional spaces (Figure 7). Both groups stated that wall features on scenes, including wall lighting fixtures, were different from models more often than others. However, Koreans were more likely to correctly detect changes on walls (Chi sq.=4.077, $p=.043$), including artwork (Chi sq.=4.688, $p=.030$), while European Americans were more likely to indicate such changes on different scenes other than where the cues were located in the models. This is consistent with Nisbett and colleagues' (2001, 2003, 2006) findings that European Americans remember focal objects separately from background, and thus, features on walls may be less effective for European Americans. Koreans, on the other hand, appeared worse at utilizing objects, such as overhang and furniture pieces, than European Americans (Chi sq.=6.026, $p=.014$). However, neither groups appeared to successfully use them. In addition, the present study identified features less effective as wayfinding cues: ceiling and wall lighting fixtures including a large feature lighting in a main lobby, ceiling design, wall finishes,

corridor width change, and doors and windows.

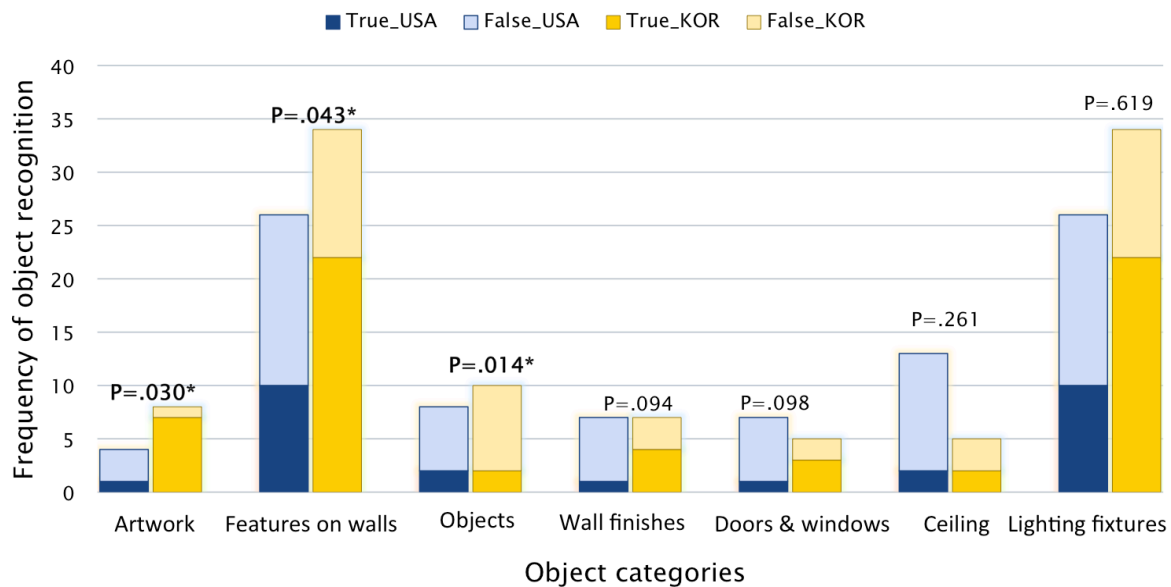


Figure 7. Features mentioned in recall questionnaire. Participants indicated different features from the models they saw. Both cultural groups of participants said features on the walls were changed; however, European Americans less likely associated them with the features' locations¹¹.

Since major portions of the models were walled, wall finishes, doors and windows, lighting fixtures were on participants' sides as they traversed the space. Thus, they might have been perceived as peripheral elements. The present study redefined cues based on their locations: on the path (landmarks) versus on the side or ceiling (background). The recall test results showed difference between the two cultural groups (Chi sq.=6.114, $p=.013$); however, it was less significant than the original definition (Chi sq.=11.283, $p=.001$).

Standard cognitive index (change blindness test)

The first two pairs of scenes in the standard cognitive index were considered

¹¹ 'Features on walls' took in artwork, overhang, wall lighting fixture, windows and doors, wall finishes, and first-aid station. 'Object' category included artwork, furniture, first-aid station, facing windows, a large ceiling lighting fixture in a lobby.

practice trials and thus discarded for analysis. Korean participants exhibited shorter mean reaction time for either focal or background object changes (Figure 8). This means that they were better at recognizing both focal and background feature changes than European American participants. Both focal object and background changes showed statistical significance between the two cultural groups ($t(44)=-2.345$, $p=.024$, $t(44)=-2.514$, $p=.016$, respectively). However, the difference reaction time between focal object change and background change was not different between the two groups ($t(45)=-1.107$, $p=.274$).

Collectivism-individualism scale

Consistent with prior research that East Asians are more collectivist and less individualistic than European Americans, Koreans in this study were marginally more collectivist ($M=97.09$, $t(44)=1.389$, $p=.172$) and less individualist ($M=88.96$, $t(44)=-3.093$, $p=.003$) than European Americans ($M=91.61$, 99.26 , respectively, Figure 9).

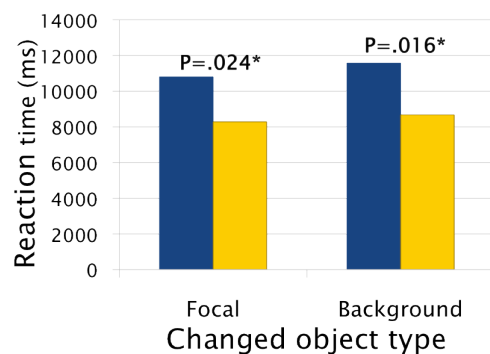


Figure 8. Standard cognitive index (change blindness) results. Reaction time is the amount of time spent until recognizing changes. Koreans were less time to identify both focal and background feature changes.

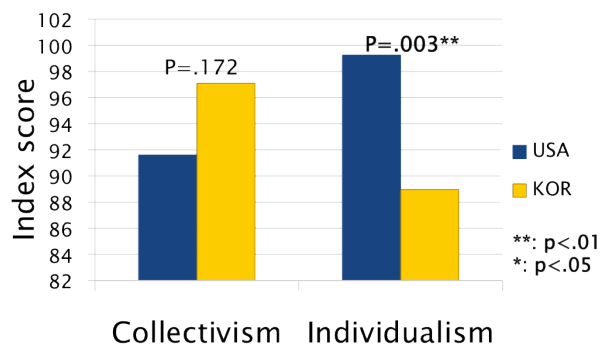


Figure 9. Individualism-collectivism scale results. European Americans were more individualistic and less collectivist than Koreans.

CHAPTER 4

DISCUSSION

Findings

The objectives of the experiment were to determine 1) whether European Americans and Koreans would show differences in the perception and recognition of focal and background cues during wayfinding, 2) if specific types of cues would be more effective for either of the two cultural groups, 3) whether the two groups would confirm the individualism-collectivism theory of cultural differences in visual perception, and 4) to suggest design guidelines for architects and interior designers. The present study hypothesized Koreans would be better at utilizing background cues in wayfinding than European Americans based on visual perception literature. Cue types and cultural background influenced the participants' wayfinding performance. In addition, d' (signal detection) and C (risk taking) analyses showed that Koreans detected cues more accurately than European Americans. However, there was no interaction between ethnicity and cue type.

Nisbett and colleagues (2001, 2003, 2006) found East Asians pay more attention to background features than European Americans who focus on salient features in two-dimensional scenes. The former, consequently, are more sensitive to background changes than the latter. Yet, the two cultural groups' visual perception differences herein did not appear to affect their wayfinding performance when they were exposed to landmark or background cues in a three-dimensional space even though the groups showed difference in the recall test. One plausible explanation is that visual perception in three-dimensional spaces is not the same as in static images. Perhaps to be effective, wayfinding cues in three-

dimensional spaces need to be more salient than in static images. Considering that hotels often prefer neutral or homogenous colors throughout interior spaces, the present study constrained unrealistic color contrast in the hotel models. Thus, the finish contrasts in the models may have been less substantial than in urban spaces or in other building types. Another possible explanation for the two groups' equivalent wayfinding performance in the present study is the use of a virtual medium that depicted the simulated spaces smaller than in reality. This could make environmental cues less prominent.

Some features were expected to be landmark cues: unique or contrasting finishes, distinct architectural features, and objects associated with height (Carlson et al., 2010; Evans et al., 1980; Kaplan et al., 1998; Lynch, 1960). Unlike in Evans et al.'s (1980) study, distinctive finishes were not salient in the present study. When a corridor has a light gray wall finish on top of dark wood panels on one side and yellowish marble on the other side, for instance, participants did not notice this during the guided tour and wayfinding task. Instead, they indicated it was a change in the recall test. Additionally, wider corridors are associated with public space (Ching, 1979); however, wider corridor width in the present study was largely ineffective in leading either cultural group to the lobby that was on the way to the given destination.

The effectiveness of some architectural features varied between the two cultural groups, while others were not effective for either of them. Lynch (1960) suggested that landmarks are often associated with height, so that they are not visually blocked and can be referenced from a distance. Hence, the present study hypothesized that a large ceiling lighting fixture in the lobby would be a landmark cue whereas ceiling design changes in corridors would be background cues. The results showed that European Americans did not

remember the large lighting fixture from navigation, but they paid more attention to it in the two-dimensional scene in the recall questionnaire. Thus, visual perception differences of static stimuli may not necessarily be consistent with three-dimensional spaces. In general, features lateral to the participants, such as wall sconces and doors, appeared to be more effective for Koreans while they caused more recall errors among European Americans. This was not expected from literature review; however, cue locations in real space may influence the degree of their salience in wayfinding. Additionally, ceiling design changes were not effective for either of the two groups. Although previous studies using urban spaces found that bright surfaces were salient (Appleyard, 1976) and that overhangs could be effective cues (Arthur & Passini, 1992), a golden overhang on a dark-colored corridor wall in the present study was not effective for either of the cultural groups. Furthermore, Koreans did not recall a window view to a small, brick-walled courtyard at the end of a corridor as effectively as European Americans did. This may mean the European American participants perceived window and its view to a courtyard as a landmark cue even though the outdoor view had a similar color scheme to the indoor.

European Americans attend to the attributes of each object while East Asians look for similarities and relationships between objects (e.g., Nisbett & Masuda, 2003; Nisbett & Miyamoto, 2005). Thus, the former perceive focal objects independently from their background scenes. Consistent with this, the cue recognition test results showed that European Americans were less likely to associate salient features (e.g., a painting or a piece of furniture) with the features' surroundings (e.g., adjacent wall finishes). As a result, artwork and furniture were more effective for Koreans' recall than for European Americans. European Americans made more errors saying such salient cues were missing at incorrect

locations. Researchers theorize that one possible origin of Westerners' and Easterners' visual perception difference is individualism and collectivism (e.g., Masuda & Nisbett, 2006; Nisbett, 2003; Triandis, 1995). The two cultural groups' individualism-collectivism scale scores in the present study partially supported this hypothesis. The two groups in this study showed differences, but only in individualism scores. The absence of a cultural difference in collectivism might mean young adults in Korea have become less collectivist, which the researcher have read similar stories on Korean newspapers.

It is unclear why American and Korean participant groups in this study did not follow Nisbett et al.'s (2001, 2003, 2006) standard cognition (change blindness) test results in which East Asians were better at recognizing background feature changes than European Americans whereas European Americans were similar or slightly better at detecting focal object changes. In the present study, Koreans demonstrated shorter reaction time to both landmark and background stimuli. One explanation could be the different pace of everyday life in the two locations where the experiment was performed. Life pace in Korea, especially in Seoul where Hongik University's main campus is located, is faster than the one in the United States. Faster everyday life pace could have resulted in faster reactions in general. Another explanation could be the availability of advanced information technology in Korea. Korea is a leading country in information technology. The Internet speed in Korea, for instance, is much faster than in the United States (McDonald, 2011; Smith, 2012). Hence, Korean participants could have developed faster reaction pattern to stimuli on monitors.

One contribution of the present study is that it attempted to integrate cognitive science studies with the wayfinding literature. Specifically, it explored visual perception

differences between Eastern and Western cultures in three-dimensional spaces based on the two cultures' visual perception divergences on two-dimensional scenes. It appeared that the participants' cue perception in three-dimensional spaces partially supported previous studies' findings about two-dimensional visual perception and wayfinding, which did not, however, lead to wayfinding performance differences. Even though the visual perception differences did not hold true in wayfinding in unfamiliar buildings, it is worth investigating further. This is useful both for academic research and for architectural practices- particularly large buildings that expect visitors from diverse cultures.

Limitations

The primary limitations of the present study were the use of virtual space and monitor size. The use of virtual space enabled us to isolate visual stimuli for testing by removing other sensory cues, such as motion cues, people in the space, signage, daylight, and sound. However, the models were presented smaller than they would appear in real life. Thus, there is a possibility that landmark and background features did not vary enough on screen in the effectiveness as wayfinding cues. In addition, the simulation software (UDK) provided an easy navigation interface; yet, the quality of rendering was not as realistic as other architectural rendering software, particularly because the number of light sources it could handle was very limited. Lastly, because of the use of convenience sample and small sample size, there is some possibility that the two sample groups were not equivalent besides their cultural background.

Design implications

The present study isolated one environmental cue at a time to test the salience of the cues and whether they varied in importance among cultural background. Even though

participants could distinguish altered scenes, the probabilities of recognizing alterations correctly were low in both groups. Moreover, hotel organizations and designers tend to refrain from using highly contrasting or very bright colors but prefer rather neutral or relatively homogenous color schemes in interior spaces as well as in signage design. As many cues were not equally helpful between the two cultural groups and among individuals in the present study, the use of multiple cues at decision points is likely more effective in wayfinding design. Additionally, designers should not rely on cues that require social legibility, especially for buildings expecting unfamiliar visitors with diverse cultural backgrounds.

Guestroom areas or floors, in particular, provide the least architectural distinctiveness among hotel's component spaces. In addition to homogenous interior finishes throughout, double-loaded corridor configurations, in which guestrooms are arranged on both sides of a long corridor, typically block exterior views from the corridor. Such a space will lack wayfinding cues and probably cause customers to be hesitant in choosing their routes from the elevators or from their rooms. Participants in the present study also got more confused in such corridors than in other areas, such as lobbies. It is advisable to create asymmetry using architectural features, for instance, a window or a few furniture pieces at only one end of a corridor or toward an elevator hall, instead of locating them at both ends. Perhaps, a few furniture pieces and a window on one end can create more distinctive asymmetry. The present study controlled illumination level throughout to test the salience of architectural features as wayfinding cues; in real space design, however, lighting can make such asymmetry more prominent.

Unexpectedly, a corridor that had different wall finishes on facing walls confused

participants. Thus, designers may need to restrain such design approaches where visitors will likely get lost or confused. One better use of distinct wall finish may be when one finish is distinct enough to be a feature wall. Lighting design that emphasizes the feature wall will make it more effective as a wayfinding cue. In the present study, many participants in either cultural group remembered artwork; however, European Americans were not able to associate them with the background scene of where it was located. Instead, they indicated other scenes were missing the painting. Thus, artwork alone may be ineffective to orientation. One strategy designers may consider, depending on building types, is to use the same type of cue repetitively – for example, put a piece of artwork on the direction to a main lobby or an elevator hall.

Directions for future research

To overcome scale reduction on the monitor, future studies could use head-mounted display or full-scale projection. Eye-tracking could also be useful to reveal where different cultural groups look in real or simulated spaces. These glances could then be compared to what they remember and recognize. If such devices are not available, then use of a narrower FOV may be considered depending on virtual space design.

The present study tested only a limited set of design and spatial features. Future studies are encouraged to examine a wider range of environmental features with varying environmental complexity and context. Adopting Brunswik's view that people utilize only a small portion of various cues available but no single cues are effective for everybody (Gifford, 2007, p.29), future research may include multiple cues around a route decision point to see which ones are more effective. In addition, to investigate decision-making process further, thinking-out-loud protocols could be adopted during wayfinding tasks

(Evans, 1980; Ruddle & Lessels, 2006). Furthermore, this study only compared European Americans and Koreans based on previous studies of visual perception differences. Now, we are living in a global world where travelling abroad has become more common than ever. Thus, future studies may include diverse ethnicity groups in addition to East Asians and European Americans. The present study has not identified any specific cues in the experiment that are more sensitive to cultural background, but legibility should be examined carefully when involving cultural variables. Lastly, future studies may want to exclude gamers in sample pool because gamers appeared to behave differently compared to non-gamers. Specifically, they tended to move fast and appeared less concerned about where they were going as if they were running away from enemies in a video game.

In conclusion, this study examined cultural differences in wayfinding cue perception, integrating cognitive science and wayfinding literatures for the first time. The present study tested cultural differences among Westerners and Easterners in utilizing various interior features as cues in wayfinding. The particular groups' wayfinding performance in the present study did not differ. However, the two cultural groups demonstrated some differences in recall of cues. Cultural background did appear to influence visual perception in spaces, partially following previous research that used static stimuli, even though it did not affect wayfinding performance. In addition, this study offered design guidelines for designers and architects who create spaces often used by new visitors. Future studies are encouraged to investigate visual cue perception in wayfinding further, for example, with think-aloud method or eye-tracking. Lastly, it will be worth exploring the thresholds of visual cues in buildings that influence visitors' wayfinding.

APPENDIX A

CONSENT FORM

I am asking you to participate in a research study. This form is designed to give you information about this study. I will describe this study to you and answer any of your questions.

What the study is about

The purpose of this research is to investigate how architectural planning and interior design affect people's wayfinding in unfamiliar hotel environments. In addition, this research is to explore the relationship between cognition ability and wayfinding behavior.

What we will ask you to do

I will ask you to complete three components: a navigation experiment, a questionnaire/interview, and a cognitive test. Each component will take approximately ten minutes; so the whole session will take about 30 minutes. In the experiment, first you will be asked to get familiar with utilizing a computer keyboard and a mouse to navigate a virtual environment up to five minutes. Then, you will follow a guided tour of a hotel environment on the computer screen and then be informed a destination in the environment. You will utilize the computer keyboard and mouse to reach to the destination. When you find the destinations in the two different environments, the experiment will be over. The questionnaire/interview and the cognitive test will be followed.

Risks and discomforts

Because this experiment is similar to a computer game, I do not anticipate any risks from participating in this research.

Benefits

There are no foreseen benefits of participation in this research.

Alternatives

There are not any non-experimental alternatives in this research.

Payment for participation

Participants will receive one (1) research participation credit.

Computer Screen Recording

This study will record the navigation sequences as seen on the monitor. No physical appearance of the participants will be collected for this experiment. The record will be analyzed only for this study, and some of the screen capture images of the navigation record may be used for publication, presentation, or other promotional purpose. The participant's private information will not be revealed in any case, and the participant does not have rights to inspect or approve the use of the images for the purposes mentioned above. After completion of the research, the record will be archived confidentially.

Please sign below if you are willing to have this navigation experiment saved in video file format. You may not participate in this study if you are not willing to have the navigation recorded.

- ☐ I do not want to have this experiment recorded.
- ☐ I am willing to have this navigation experiment recorded and to allow screen capture images to be used in publications, presentations, or other promotional purposes:

Signed: _____

Date: _____

Privacy/Confidentiality

This research will not collect any biometric information or private information (such as mailing/email address or phone number) of the participant to protect participant's privacy and confidentiality.

Taking part is voluntary

The participant's involvement in this study is voluntary. If you feel uncomfortable during this study, you can refuse to participate before the study begins, discontinue at any time, or skip any questions/procedures with no effect on the compensation earned before withdrawing or penalty to you. If you are uncertain at any time during this process, you can ask the facilitator for further clarification.

The main researcher conducting this study is Giyoung Park, a graduate student at Cornell University. If you have questions or concerns, please direct them to Giyoung Park at gp249@cornell.edu. If you have any questions or concerns regarding your rights as a subject in this study, you may contact the Institutional Review Board (IRB) for Human Participants at 607-255-5138 or access their website at <http://www.irb.cornell.edu>. You may also report your concerns or complaints anonymously through Ethicspoint online at www.hotline.cornell.edu or by calling toll free at 1-866-293-3077. Ethicspoint is an independent organization that serves as a liaison between the University and the person bringing the complaint so that anonymity can be ensured.

You will be given a copy of this form to keep for your records.

Statement of Consent

I have read the above information, and have received answers to any questions I asked. I consent to take part in the study.

Your Signature _____ Date _____

Your Name (printed) _____

Signature of person obtaining consent _____ Date _____

Printed name of person obtaining consent _____

This consent form will be kept by the researcher for at least five years beyond the end of the study.

APPENDIX B

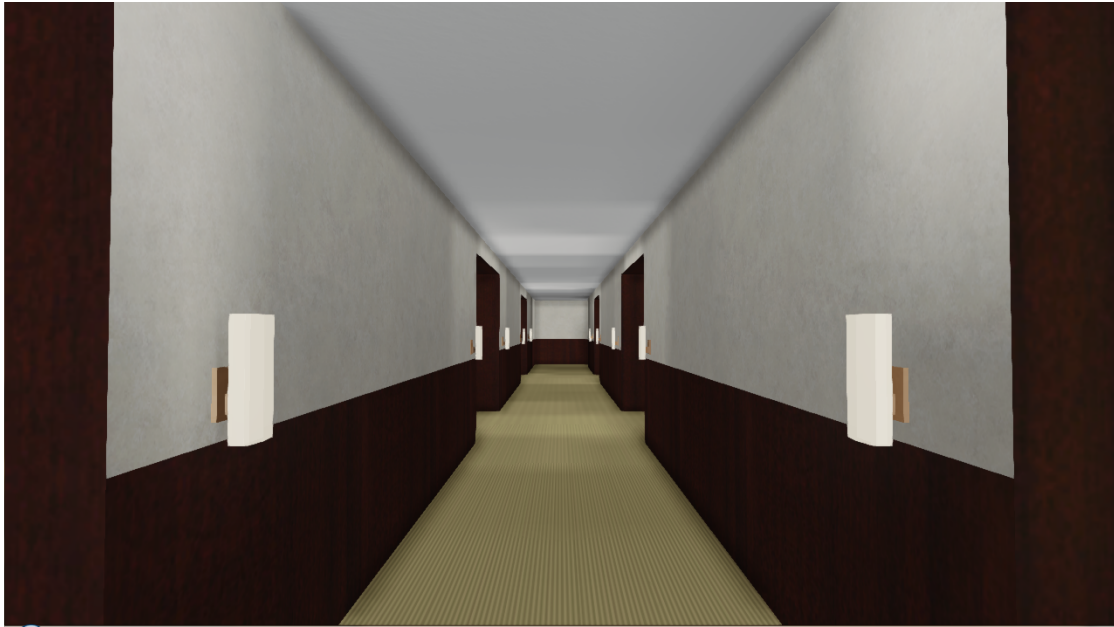
EXPERIMENT RECALL QUESTIONNAIRE



1. Hotel 2-B, decision point 2: Artwork on facing wall (landmark cue).



2. Hotel 1-A, decision point 4: trees, tables, and chairs (landmark cue).



3. Hotel 2-B, decision point 1: no cue condition.



4. Hotel 1-B, decision point 1: recessed ceiling lighting (background cue).



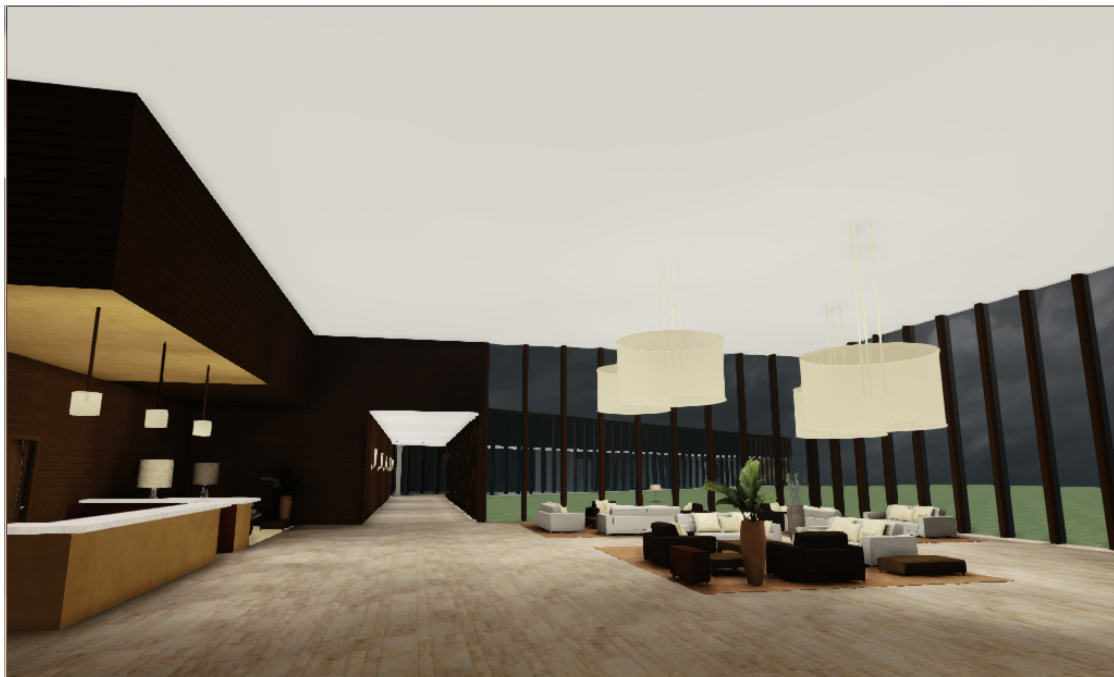
5. Hotel 1-B, decision point 3: view to garden with moderate finish change (landmark cue).



6. Hotel 2-A, decision point 5: First-aid station.



7. Hotel 2-A, decision point 4: Wall colors on corridor (background cue)



8. Hotel 1-A, decision point 5. Angle of building component (background cue)



9. Hotel 2-B, decision point 3: Corridor width change (background cue)



10. Hotel 1, decision point 2: no cue condition.

APPENDIX C

INDIVIDUALISM-COLLECTIVISM SCALE

This questionnaire is anonymous, and there are no right or wrong answers. If you strongly agree with the statement, enter 9; and if you strongly disagree, enter 1 next to the statement. If you are not sure or neutral, enter 5.

| | | | | | | | | | | |
|----------------------|---|---|---|---|---|---|---|---|---|-------------------|
| Strongly disagree | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Strongly agree |
|----------------------|---|---|---|---|---|---|---|---|---|-------------------|

1. I prefer to be direct and forthright when I talk with people. _____
2. My happiness depends very much on the happiness of those around me. _____
3. I would do what would please my family, even if I detested that activity. _____
4. Winning is everything. _____
5. One should live one's life independently of others. _____
6. What happens to me is my own doing. _____
7. I usually sacrifice my self-interest for the benefit of my group. _____
8. It annoys me when other people perform better than me. _____
9. It is important for me to maintain harmony within my group. _____
10. It is important to me that I do my job better than others. _____
11. It like sharing little things with my neighbors. _____
12. I enjoy working in situations involving competition with others. _____
13. We should keep our aging parents with us at home. _____
14. The well-being of my co-workers is important to me. _____
15. I enjoy being unique and different from others in many ways. _____
16. If a relative were in financial difficulty, I would help within my means. _____
17. Children should feel honored if their parents receive a distinguished award. _____
18. I often do "my own thing." _____
19. Competition is the law of nature. _____
20. If a co-worker gets a prize I would feel proud. _____
21. I am a unique individual. _____
22. To me, pleasure is spending time with other. _____
23. When another person does better than I do, I get tense and aroused. _____

24. I would sacrifice an activity that I enjoy very much if my family did not approve of it.

25. I like my privacy. _____

26. Without competition it is not possible to have a good society. _____

27. Children should be taught to place duty before pleasure. _____

28. I feel good when I cooperate with others. _____

29. I hate to disagree with others in my group. _____

30. Some people emphasize winning; I am not one of them. _____

31. Before taking a major trip, I consult with most members of my family and many friends. _____

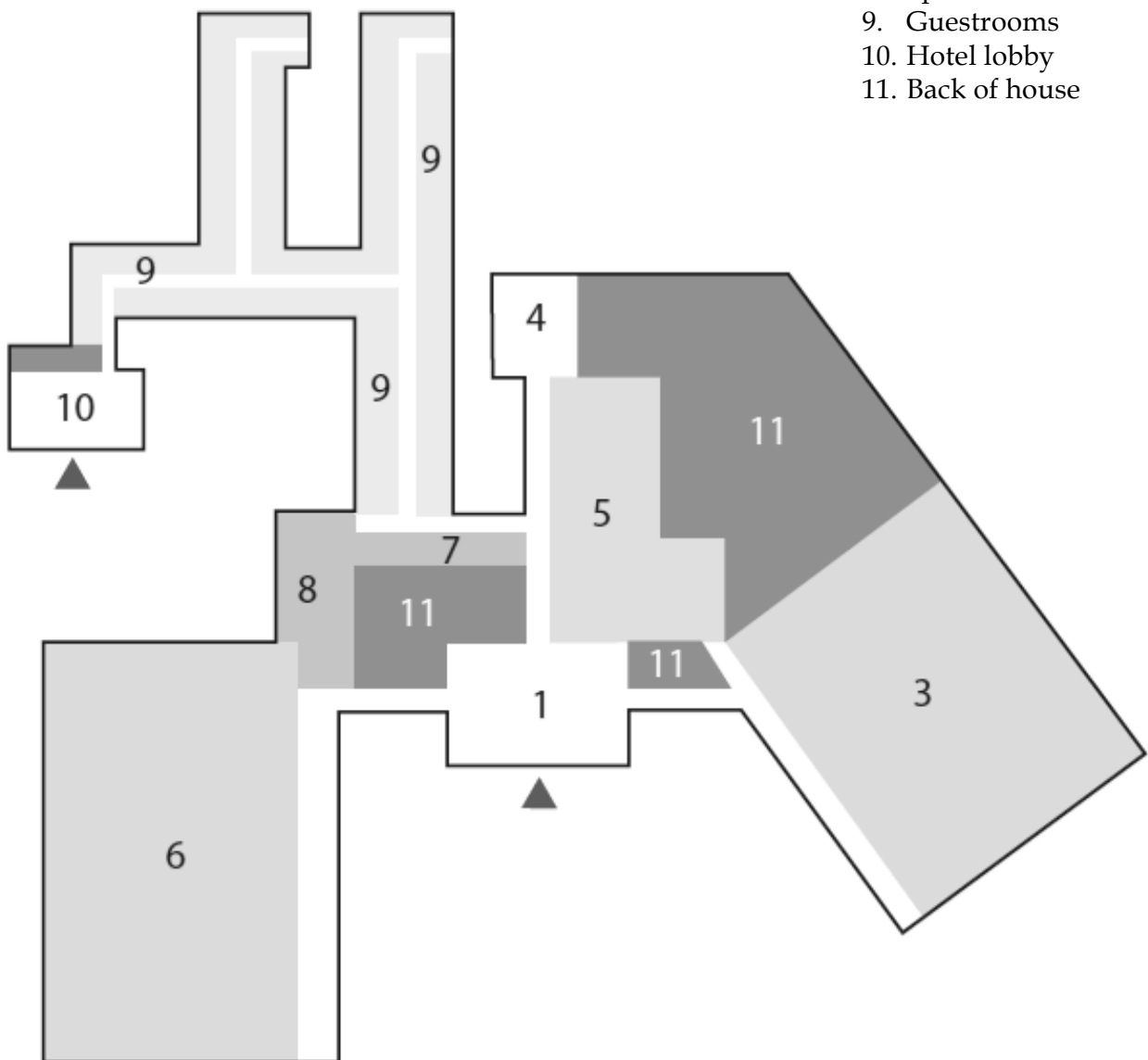
32. When I succeed, it is usually because of my abilities. _____

APPENDIX D

HOTEL FLOOR PLANS

Hotel 1 (Conference Hotel)

1. Main lobby
2. Convention
3. Meeting rooms
4. Restaurant
5. Banquet
6. Exhibition
7. Business center
8. Spa and fitness
9. Guestrooms
10. Hotel lobby
11. Back of house



Hotel 2 (Medical Mixed Hotel)

1. Main lobby
2. Guestrooms
3. Wellness & clinic
4. Spa and fitness
5. Lecture rooms
6. Conference
7. Meeting rooms
8. Medical R&D
9. R&D Center lobb
10. Back of house or unassigned



APPENDIX E

Q-SORT SURVEY IMAGES

Q-sort set 1







Q-sort set 2







APPENDIX F

GUIDED TOUR INSTRUCTIONS

(Participants were overviewed what component spaces were in each hotel prior to the guided tour.)

- | | |
|---------|--|
| Hotel 1 | <ol style="list-style-type: none">1) This is the main lobby.2) This is the convention.3) This is the meeting room area.4) This is the exhibition.5) This is the restaurant.6) The rooms on the left are business center.7) This is the spa.8) These rooms are guestrooms.9) This is your room.10) This is the hotel lobby. |
| Hotel 2 | <ol style="list-style-type: none">1) This is the main lobby.2) This is the guestroom wing.3) This is your room.4) This is the well-being center wing.5) This is the first-aid station.6) There are the lecture rooms where health-related classes and workshops are held.7) This is the spa.8) This is the conference area.9) These are the meeting rooms.10) This is the medical R&D center. |

REFERENCES

- Air Quality Sciences, Inc. (2008). *Indoor Air Quality & Sensitive Population Groups*. Retrieved 2012 йил 5-Dec from GREENGUARD Environmental Institute:
http://www.greenguard.org/Libraries/GG_Documents/Reformat_IAQ_and_Sensitive_Populations_FINAL_2.sflb.ashx
- Appleyard, D. (1976). *Planning a pluralist city: Conflicting realities in Ciudad Guayana*. Cambridge, MA: MIT Press.
- Archea, J. (1977). The place of architectural factors in behavioral theories of privacy. *Journal of social issues* , 33 (3), 116-136.
- Arthur, P., & Passini, R. (1992). *Wayfinding: People, signs, and architecture*. New York: McGraw-Hill.
- Bakan, D. (1966). *The duality of human existence*. Chicago: Rand McNally.
- Barry, M. (2001). Exploring isovist fields: space and shape in architectural and urban morphology. *Environment and Planning B: Planning and Design* , 28, 123 ^ 150.
- Bornstein, M. H., Azuma, H., Tamis-LeMonda, C., & Ogino, M. (1990). Mother and infant activity and interaction in Japan and in the United States: I. A comparative macroanalysis of naturalistic exchanges. *International Journal of Behavioral Development* , 13 (3), 267-287.
- Brown, B., Wright, H., & Brown, C. (1997). A post-occupancy evaluation of wayfinding in a pediatric hospital: Research findings and implications for instruction. *Journal of Architectural and Planning Research* , 14 (1), 35-51.
- Carlson, L. A., Hölscher, C., Shipley, T. F., & Dalton, R. C. (2010). Getting lost in buildings. *Current Directions in Psychological Science* , 19, 284-289.
- Carpman, J. R., Grant, M. A., & Simmons, D. A. (1985). Hospital design and wayfinding. *Environment and Behavior* , 17 (3), 296-314.
- Ching, F. (1979). *Architecture, form, space, & order*. New York: Van Nostrand Reinhold.
- Chiu, L.-H. (1972). A Cross-Cultural Comparison of Cognitive Styles in Chinese and American Children. *International Journal of Psychology* , 7 (4), 235-242.
- Chua, H. F., Leu, J., & Nisbett, R. E. (2005 йил Jul). Culture and Diverging Views of Social Events. *Social Psychology Bulletin* , 31 (7), pp. 925-934.
- Cousins, S. D. (1989). Culture and self-perception in Japan and the United States. *Journal of Personality and Social Psychology* , 56 (1), 124-131.
- Craik, K. H. (1973). Environmental Psychology. *Annual Review of Psychology* , 24, 403-422.
- Davis, L. S., & Benedikt, M. (1979). Computational models of space: Isovists and isovist fields. *Computer Graphics and Image Processing* , 11, 49-72.
- Duffy, S., Toriyama, R., Itakura, S., & Kitayama, S. (2009). Development of cultural strategies of attention in North American and Japanese children. *Journal of Experimental Child Psychology* , 102 (3), 351-359.

- Evans, G. W. (1980). Environmental cognition. *Psychological Bulletin* , 88 (2), 259-287.
- Evans, G. W., & Gärling, T. (1991). Environment, cognition, and action: The need for integration. In T. Gärling, & G. W. Evans, *Environment, cognition, and action* (pp. 3-13). New York: Oxford University Press.
- Evans, G. W., Fellows, J., Zorn, M., & Doty, K. (1980). Cognitive mapping and architecture. *Journal of Applied Psychology* , 65 (4), 474-478.
- Evans, G. W., Marrero, D. G., & Butler, P. A. (1981). Environmental learning and cognitive mapping. *Environment and Behavior* , 13 (1), 83-104.
- Evans, G. W., Skorpanich, M. A., Gärling, T., Bryant, K. J., & Bresolin, B. (1984). The effects of pathway configuration, landmarks and stress on environmental cognition. *Journal of Environmental Psychology* , 323-335.
- Evans, G. W., Smith, C., & Pezdek, K. (1982). Cognitive maps and urban form. *Journal of the Americal Planning Association* , 48 (2), 232-244.
- Evans, G., & McCoy, J. M. (1998). When buildings don't work: The role of architecture in human health. 18, 85-94.
- Fernald, A., & Mirikaway, H. (2005). Common themes and cultural variations in Japanese and American mothers' speech to infants. *Child Development* , 64, 637-656.
- Galea, L. A., & Kimura, D. (1993). Sex differences in route-learning. *Personality and Individual Differences* , 14 (1), pp. 53-65.
- Gifford, R. (2007). Environmental perception and spatial cognition. In R. Gifford, *Environmental psychology* (4th ed., pp. 22-59). Colville, WA, USA: Optimal Books.
- Gopnik, A., & Choi, S. (1995). Names, relational words, and cognitive development in English and Korean speakers: Nouns are not always learned before verbs. In M. Tomasello, & W. Merriman (Eds.), *Beyond names for things: Young children's acquisition of verbs* (pp. 63-80). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Hall, E. T. (1990). *The hidden dimension* (Reprint. Originally published: Garden City, N.Y. : Doubleday, 1966. ed.). New York, NY: Anchor Books.
- Haq, S. (2003). Investigating the syntax line: configurational properties and cognitive correlates. *Environment and Planning B: Planning and Design* , 30 (6), 841-863 .
- Haq, S., & Zimring, C. (2003). Just down the road a piece: The development of topological knowledge of building layouts. *Environment and Behavior* , 35, 132-160.
- Hildebrand, G. (1999). *Origins of architectural pleasure*. Berkeley: University of California Press.
- Hillier, B. (1996). *Space is the machine: A configurational theory of architecture*. Cambridge: Cambridge University Press.
- Hillier, B., & Tzortzi, K. (2006). Space syntax: The language of museum space. In S. Macdonald, *A companion to museum studies* (pp. 282-301). Oxford, UK: Blackwell Publishing.
- Hong, Y.-Y., Morris, M. W., Chiu, C.-Y., & Benet-Martínez, V. (2000). Multicultural minds: A dynamic constructivist approach to culture and cognition. *American Psychologist* , 55 (7), 709-720.

- Kanagawa, C., Cross, S. E., & Markus, H. R. (2001 йил Jan). "Who am I?" The cultural psychology of the conceptual self. *Personality and Social Psychology Bulletin* , 27 (1), pp. 90-103.
- Kaplan, R., & Kaplan, S. R. (1998). *With people in mind*. Washington, D.C.: Island Press.
- Kitayama, S., & Uskul, A. K. (2011). Culture, mind, and the brain: Current evidence and future directions. *Annual Review of Psychology* , 62, 419-449.
- Kluckhohn, F., & Strodtbeck, F. (1961). *Variations in value orientatations*. Evanston, IL: Row, Peterson.
- Koh, G., von Wiegand, T., Garnett, R., Durlach, N., & Shinn-Cunningham, B. (1999). Use of Virtual Environments for Acquiring Configurational Knowledge about Specific Real-World Spaces: I. Preliminary Experiment. *Presence Teleoperators and Virtual Environments* , 8 (6), 632-656.
- Lawton, C. (1994). Gender differences in wayfinding strategies: Relationship to spatial ability and spatial anxiety. *Sex Roles* , 30 (11/12), 765-779.
- Lawton, C., Charleson, S., & Zieles, A. (1996). Individual- and gender related differences in indoor wayfinding. *Environment and Behavior* , 28 (2), 204-219.
- Lynch, K. (1960). *The image of the city*. Cambridge: The MIT Press.
- Masuda, T., & Nisbett, R. E. (2006). Culture and change blindness. *Cognitive Science* , 30, 381-399.
- Maurer, R., & James, C. (1972). Images of the neighborhood and city among black, anglo, and Mexican- American children. *Environment and Behavior* , 4 (4), 351-388.
- Miyamoto, Y., Nisbett, R. E., & Masuda, T. (2006). Culture and the physical environment. 17 (2), 113-119.
- Nisbett, R. E. (2003). *The geography of thought: How Asians and Westerners think differently... and why*. New York, USA: Free Press.
- Nisbett, R. E., & Masuda, T. (2003). Culture and point of view. *The National Academy of Sciences of the USA* , 100 (19), 11163-11170.
- Nisbett, R. E., & Miyamoto, Y. (2005). The influence of culture: holistic versus analytic perception. *Trends in Cognitive Sciences* , 9 (10), 467-473.
- Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review* , 108 (2), 291-310.
- Norman, D. A. (1988). *The psychology of everyday things*. New York: Basic Books.
- Passini, R. (1984). *Wayfinding in architecture*. New York: Van Nostrand Reinhold Company, Inc.
- Peng, K., & Knowles, E. (2003). Culture, Education, and the Attribution of Physical Causality. *Personality and Social Psychology* , 29 (10), 1272-1284.
- Peponis, J., Zimring, C., & Choi, Y. (1990). Finding the building in wayfinding. *Environment and Behavior* , 22 (5), 555-590.
- Pezdek, K., & Evans, G. W. (1979). Visual and verbal memory for objects and their spatial location. *Journal of Experimental Psychology: Human Learning and Memory* , 5 (4), 360-373.

- Ruddle, R. A., & Lessels, S. (2006). Three levels of metric for evaluating wayfinding. *Presence: Teleoperators and Virtual Environments* , 15 (6), 637-654.
- Rutes, W. A., Penner, R. H., & Adams, L. (2001). *Hotel Design, Planning, and Development*. New York: W. W. Norton & Company.
- Skorupka, A. (2009). Comparing human wayfinding behavior in real and virtual environment. *The 7th International Space Syntax Symposium*, (pp. 104:1-104:7). Stockholm.
- Sternberg, E. M. (2009). *Healing spaces*. Cambridge, MA: The Belknap Press of Harvard University.
- Stokols, D. (1995). The paradox of environmental psychology. *American Psychologist* , 50 (10), 821-837.
- Tardif, T. G., & Xu, F. (1999). Putting the "noun bias" in context: A comparison of English and Mandarin. *Child Development* , 70 (3), 620-635.
- Tardif, T., Shatz, M., & Naigles, L. (1997). Caregiver speech and children's use of nouns versus verbs: A comparison of English, Italian, and Mandarin. *Journal of Child Language* , 24 (3), 535-565.
- Triandis, H. C. (1995). *Individualism & collectivism*. Boulder, San Francisco Oxford: Westview Press.
- Triandis, H. C., McCusker, C., & Hui, C. H. (1990). Multimethod probes of individualism and collectivism. *Journal of Personality and Social Psychology* , 1006-1020.
- Ulrich, R., Zimring, C., Quan, X., Anjali, J., & Choudhary, R. (2004). *The role of the physical environment in the hospital of the 21st century: A once-in-a-lifetime opportunity*. Center for Health Design.
- Walsh, D., Krauss, I., & Regnier, V. (1981). Spatial ability, environmental knowledge, and environmental use: The elderly. In L. S. Liben, A. H. Patterson, & N. Newcombe (Eds.), *Spatial representation and behavior across the life span: Theory and application* (pp. 299-304). New York: Academic Press, Inc.
- Weber, R. J., Brown, L. T., & Weldon, K. (1978). Cognitive maps of environmental knowledge and preference in nursing home patients. *Experimental Aging Research* , 4 (3), 157-174.
- Weisman, J. (1981). Evaluating Architectural legibility: Way-finding in the built environment. *Environment and Behavior* , 13 (2), 189-204.
- Witkin, H. A., & Berry, J. W. (1975). Psychological differentiation in cross-cultural perspective. *Journal of Cross-Cultural Psychology* , 6, 4-87.